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THE UNIVERSITY OF WYOMING

DEPARTMENT OF GEOLOGY

GEOLOGY BUILDING

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Gentlemen:

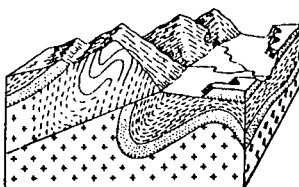
Please find enclosed the first Type 1 report for the University of Wyoming ERTS-1 investigation. Since the initial writing of this report, we have received our first ERTS-1 images for Wyoming (Sept. 8, 1972).

On Sept. 13, Dr. Nicholas Short provided us with a MSS band 5 image of an area of central Wyoming including the Sweetwater Rocks area discussed on pages 2 and 3 of this report. Preliminary inspection of this image indicates that discrimination of the metasedimentary sequences in the Sweetwater Rocks area may, indeed, be possible using the ERTS-1 imagery. Thus, the ERTS imagery might be useful as an indicator of the metaseoimentary zones containing iron formation.

The outcrops of iron formation discussed in this report were located during the preliminary portion of the Wyoming investigation, but we feel that there is a very real possibility of using the ERTS-1 data as an aid in locating other such bodies. Therefore, we have reported this find as a "significant result" of the University of Wyoming ERTS program.

We would like to emphasize three factors concerning the discovery of iron formation, listed below:

1. The discovery was made by use of aircraft imagery (Mission 184) flown in support of the Wyoming ERTS program.
2. The body of iron formation is not large enough to be of economic value at present.
3. The initial discovery of iron formation in the general area, although not the study area, was made by one of our graduate students, Mr. Alfred Pekarek, and if mention is made of the find in this area, he should receive credit for the initial discovery.



N72-32339

(E72-10079) ANALYSIS OF ERTS-1 IMAGERY OF
WYOMING AND ITS APPLICATION TO EVALUATION
OF WYOMING'S NATURAL RESOURCES Progress
Report, Jul. - Aug. R.S. Houston, et al
(Wyoming Univ.) Sep. 1972 11 p CSCL 08G G3/13 00079

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TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
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7. Author(s)		6. Performing Organization Code
9. Performing Organization Name and Address Department of Geology University of Wyoming Laramie, Wyoming 82070		8. Performing Organization Report No. ERTS-1 - L-72A
12. Sponsoring Agency Name and Address Goddard Space Flight Center Greenbelt, Maryland 20771 Technical Monitor: A. Fihelly		10. Work Unit No.
15. Supplementary Notes		11. Contract or Grant No. NAS5-21799
16. Abstract <p>During report period July and August, 1972, the ERTS-1 multidisciplinary study at the University of Wyoming was hindered by lack of satellite imagery. Therefore, the major effort thus far has been toward interpretation of the intermediate - and high-altitude aircraft data which was available. Project investigators were able to delineate various structures and lithologic units in well-exposed sedimentary sequences and in regions of Precambrian igneous and metamorphic rocks. In one area, the Precambrian lithologies, which were previously unmapped, include a taconite formation which might be economically important. It is anticipated that some of the distinctions made using the aircraft data can also be made with the ERTS-1 satellite imagery.</p>		13. Type of Report and Period Covered Type I Report for July - August, 1972
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Figure 2. Technical Report Standard Title Page

We are frankly uncertain how you wish to have something of potential, but not of immediate, economic value handled. Do you wish to follow the procedure outlined in your July 21st policy statement or since this is more an illustration of how ERTS and aircraft imagery may be used to explore for mineral deposits than an actual find of economic value, may we discuss it at the symposium on September 29th?

Very truly yours,

A handwritten signature in dark ink, appearing to read "R. S. Houston". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

R. S. Houston,
Principal Investigator

RSH/eh

ANALYSIS OF ERTS-1 IMAGERY OF WYOMING AND ITS APPLICATION TO
EVALUATION OF WYOMING'S NATURAL RESOURCES

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September, 1972

Type I report for July-August 1972

Prepared for

GODDARD SPACE FLIGHT CENTER

GREENBELT, MARYLAND 20771

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OBJECTIVES OF THE CONTRACT

The principal objective of the Wyoming program is to utilize ERTS imagery and aircraft data gathered at selected altitudes, to study geological, botanical, and agricultural features of the state of Wyoming and to attempt to use this derived information to achieve practical goals in inventory and management of natural resources.

WORK SUMMARY

We have yet to receive ERTS imagery, but aircraft imagery from Mission 184 and U-2 imagery from the central Wyoming flight are available for study. Investigators have utilized this imagery for familiarizing themselves with the areas covered and with the various techniques in remote sensing. Individuals who have worked with the imagery include R. S. Houston, D. L. Blackstone, Dennis Knight, R. B. Parker, Francis Redfern, Roy Breckenridge and Ronald Marrs. Mr. Marrs has been devoting much of his time to organization of the laboratory, purchasing equipment, and defining flight parameters and ground control for the Mission 213 underflight scheduled for Sept. 9-17, 1972.

In addition to the laboratory studies, a number of field studies have been made to investigate various geological and botanical features noted in the aircraft imagery.

SIGNIFICANT RESULTS

Dr. R. B. Parker has found that by use of the combination of color and color infrared photography he has been able to subdivide a number of major lithologic units in the Precambrian rocks of the Wind River Mountains. In addition to lithologic subdivisions in gneissic terrane Dr. Parker has been

able to map dikes and fault systems that have not been previously reported in geological literature and the lithologic units and structure have been checked in the field by Dr. Parker.

Dr. D. L. Blackstone has examined the Mission 184 aircraft imagery and noted several lineaments which may represent unreported faults. He has also identified several types of geomorphic features (rock flows, polygonal ground, etc.) which are geologically significant and readily recognizable on the aircraft data. Dr. Blackstone is currently field checking his interpretations and will examine the ERTS imagery for these and other features as soon as it becomes available.

R. S. Houston has undertaken a study utilizing aircraft imagery of the Sweetwater Mountains area of Wyoming. In addition to Mission 184 aircraft imagery he is currently studying the same units utilizing U-2 multispectral photography. The purpose of this investigation was to try to make distinctions between terranes (i.e. sedimentary, metamorphic and igneous rocks of Precambrian age). Dr. Houston has been able to segregate metasedimentary rocks and granite gneisses and associated granites. Structure could be readily distinguished on 1:30,000-scale color and color infrared photography. Additional structural data were gained from the study of thermal bands. In addition to the above mentioned distinctions, fine distinctions between such units as amphibolite, hornblende gneiss and quartzite could be made within the metasedimentary succession. The metasedimentary terrane was in an area where metasedimentary rocks had not been previously reported. In an area immediately north of Dr. Houston's area, called the Rattlesnake Hills, graduate students of the University of Wyoming who studied the volcanic rocks of Rattlesnake Hills reported hornblende schist in the Precambrian of this area.

To our knowledge iron formation was first discovered in the northern area two years ago by Mr. Alfred Pekarek, graduate student of the University of Wyoming, who noted small beds of iron formation in the hornblende schist.

Dr. Houston and Mr. Marrs undertook a field study of the metasedimentary terrane in August, 1972 and found a fairly extensive body of iron formation within the metasedimentary rocks. Iron formation or taconite, is a major source of iron used by the domestic steel industry. At present there are two active iron mines in the state of Wyoming that utilize ore similar to that discovered in the Sweetwater Mountains. We do not think that the iron formation discovered by use of aircraft imagery in the Sweetwater area is extensive enough to be of economic value at present, however if we include the areas to the north where Mr. Pekarek has noted additional iron formation, the area of potential economic interest is large. Furthermore, the Precambrian rocks are partially covered by a veneer of Tertiary sedimentary rocks and it is possible that iron formation is present beneath the Tertiary cover. It is thus possible that further geological and geophysical studies may lead to the development of iron mining at some future date.

We anticipate that we will be able to distinguish metasedimentary rocks of the type studied in the Sweetwater Mountains from granitic rocks by the use of ERTS imagery. We may therefore have an illustration of multi-stage mineral exploration wherein we can use the ERTS imagery to subdivide major rock types, utilize aircraft imagery to study those of potential economic value in greater detail, and finally examine critical areas in the field in search of mineral deposits. We have at present taken precautions to see that the mineral discovery is not reported until security requirements as specified by NASA have been met.

CONFORMANCE WITH WORK SCHEDULE

Phase I (Data Analysis Preparation) of the Wyoming ERTS-1 program is essentially complete. The interpretation laboratory is equipped to receive and process ERTS imagery. Preliminary analysis of the aircraft data has been completed, and most of the instrumentation for ground truth studies has been obtained. However, there are several major equipment items which are on order but have not yet been received. All of these items, with the exception of the zoom transfer scope, have been on order for a month or more and we are anticipating delivery of these items within two weeks.

We have not yet begun phase II of the program (Preliminary Data Analysis) because we have not yet received any ERTS imagery. Thus, we are presently about 30 days behind the contract work schedule.

LABORATORY AND EQUIPMENT

Two rooms are being remodeled for a remote sensing laboratory and the work is largely complete. All of the equipment items mentioned in the proposal have been ordered with the following minor modifications:

1. James electronic thermometers and thermister probes were purchased rather than YSI thermometers and probes.
2. Weather Measure pyranometers and chart recorders were ordered in place of the Epply pyranometers.
3. A filter-wheel photometer system has been purchased in place of the ISCO spectradiometer originally proposed.

In each case, the substitution was made because the purchased item of equipment was capable of giving equal or superior results with some cost savings. The funds conserved on these equipment items were pooled with the funds provided for the purchase of a microdensitometer system, thus, providing the necessary funds for a superior microdensitometer system (Joyce-Loebl

isodensitracer) which is presently on order.

All the interpretive equipment presently in the remote sensing laboratory has been purchased by the University of Wyoming as a University contribution and they include:

2 Richards viewers (1 equipped for stereo and the other for binocular non-stereo viewing),

1 Spectral Data color-additive viewer,

1 zoom transfer microscope purchased at a cost of \$4500 (over and above the commitment made in the original University of Wyoming contribution to the grant).

STATEMENT AND EXPLANATION OF PROBLEMS

The primary problem to date has been the failure to receive ERTS imagery. We anticipate that when the imagery arrives we can undertake laboratory studies, but if this imagery is too long delayed, weather conditions are such in Wyoming that it will be difficult or impossible to make adequate field checks.

The modification by the Goddard Center of the type data that will be distributed to investigators may seriously handicap a multidisciplinary program such as ours. The studies that we undertake require that we have photography that can be used in the field. If we do not get prints from Goddard, we will be forced to modify our work plan or make the necessary prints. This will require either the development of a photo laboratory specifically for remote sensing or the development of a color processing laboratory in cooperation with existing University of Wyoming photo services. Obviously this will require additional expenditures.

ADEQUACY OF FUNDS

The project expenditures have so far been kept well in line with the budgeted funds. The only major funding problem anticipated is that which will arise if it becomes necessary to contract or equip a photo laboratory to obtain the necessary color prints. It is estimated that such an expenditure, should it be necessary, would be on the order of \$6,000.

PERSONNEL

Mr. Ronald Marrs who will receive his Ph.D. degree in geology and remote sensing from the Colorado School of Mines has been hired as a research associate and lecturer by the University. Mr. Roy Breckenridge who will receive his Ph.D. in geomorphology at the University of Wyoming in the fall of 1972 has been hired as research associate. Mr. Breckenridge is being financed from two research assistantships. We have hired him because we feel we can accomplish more with one person devoting full time to the position than we can accomplish with two people devoting part-time. Mr. Francis Redfern has been hired as a research assistant in Botany. Mr. Redfern has a double major in physics and botany and is working on the M.S. degree at the University of Wyoming. The position of research assistant in plant science has not been filled but Dr. Fisser of the plant science department has been searching for a suitable candidate.

PLANNED WORK FOR NEXT REPORT PERIOD

During the next two months we anticipate that we will receive good ERTS imagery and will be able to prepare an analysis of this. In addition, we are planning various support studies at three test sites in Wyoming during both ERTS and aircraft passes. We have set up a state-wide meeting to review various applications of the ERTS imagery for September 19, 1972. We anticipate

that Dr. Short of the Goddard Space Center will participate in this meeting and will also be able to undertake field studies utilizing ERTS imagery during September.

Mr. Marrs is currently teaching a course in remote sensing to acquaint investigators and others with the methodology in this area. The instructional costs are being paid by the University of Wyoming.

